

STATUS OF BURROWING OWLS IN ARIZONA

Final Report

by
Nikolle L. Brown and R. William Mannan



Arizona Game and Fish Department
Heritage Grant I20010

October 2002

DISCLAIMER

The findings, opinions, and recommendations in this report are those of the investigators who have received partial or full funding from the Arizona Game and Fish Department Heritage Fund. The findings, opinions, and recommendations do not necessarily reflect those of the Arizona Game and Fish Commission or the Department, or necessarily represent official Department policy or management practice. For further information, please contact the Arizona Game and Fish Department.

INTRODUCTION

Burrowing owls are considered to be generally uncommon and local residents in a variety of environments in Arizona (Phillips et al. 1964, Monson and Phillips 1981, Brown 2001a and b). The exception is in the agricultural lands along the Lower Colorado River near Yuma where they are considered to be common (Monson and Phillips 1981, Rosenberg et al. 1991). Relative to other areas within its geographic range, not much is known about burrowing owls in Arizona. Although the status of the species in this state was reviewed in 1979 (Johnson et al. 1979) and in 1986 (Johnson-Duncan et al. 1988), the results were incomplete and the overall status remains unknown.

Participants in the Second International Burrowing Owl Symposium in Ogden, Utah, (1998), concluded that the burrowing owl is declining over a majority of its range, and that there is a need for a better understanding of the relationship between burrowing owls and other fossorial animals, such as prairie dogs (*Cynomys gunnisoni*) and ground squirrels (*Citellus* sp.). The burrowing owl is already listed as a sensitive species (Endangered, Threatened, Species of Special Concern, or Sensitive) in many states, including California and Utah; and the species is classified as endangered in Canada and threatened in Mexico. At present, although the burrowing owl is on the U.S. Fish and Wildlife Service's (U.S.F.W.S.) list of Species of Management Concern (1995), it has no federal standing in the United States. However, a federal (U.S.F.W.S.) status review of the western burrowing owl has been drafted (Brown 2001a: Arizona).

There has been only one localized study conducted on burrowing owls in Arizona (in Tucson; Estabrook and Mannan 1998) and one note published on the species' diet in Arizona (in an agricultural portion of Mesa; Glover 1953). In 1998, the Arizona Game and Fish Department (AGFD) Partners in Flight Program considered the burrowing owl a Priority Species in the High Elevation Grasslands Habitat classification (Latta et al. 1999). deVos (1998) concluded that there is a need to "conserve and manage Arizona's native grassland habitats" in order to maintain populations of this species. Also more information is needed on the abundance and overall status of burrowing owls in the Arizona, so that a state conservation effort can be initiated, if information warrants such action.

In 1998, Brown (2001b) summarized existing information about burrowing owls in Arizona. A database consisting of over 250 locations (general and specific), including the Arizona Breeding Bird Atlas (ABBA) data, was created and an annotated bibliography of burrowing owls in Arizona was initiated. Brown's (2001b) effort was the first since The Birds of Arizona (Phillips et al. 1964) to compile information about burrowing owls in Arizona. However, deVos (1998) provided a general overview of the species in Arizona.

In addition to historical natural habitats, burrowing owls also use areas associated with human development (Phoenix metropolitan area, Tucson; R. Ditch, pers. comm., Estabrook and Mannan 1998) and can cause wildlife/development conflicts if the presence of the owls is not known during planning stages (G. Beatty, AGFD, pers. comm. 1998). With considerable development occurring and slated for Arizona, knowledge of the distribution of burrowing owls could reduce conflicts and provide for mitigation of important habitats and populations of owls.

This project was proposed to complete the study initiated by Brown in 1998 (Brown 2001b), and expand on the surveys initiated by Estabrook and Mannan (1998), by gathering more information on the burrowing owl in Arizona. Information on the distribution and abundance of burrowing owls in Arizona should help promote a proactive approach to the conservation and management of a species that is declining over its range.

OBJECTIVES

We proposed in this study to assess the status of the burrowing owl in Arizona at locations recorded in the past. Our objectives were to: 1) Determine presence/absence and general distribution of burrowing owls in Arizona; 2) Determine vegetation types used by burrowing owls in Arizona; and 3) Complete a literature search and other written inquiries on burrowing owls in Arizona to determine historical occurrence, habitat use, effects of land-use practices, and management needs.

METHODS

The study area encompassed the whole state. However, areas surveyed were based on records gathered by Brown (2001b) and also include records obtained since the initial inquiry (Brown pers. comm.). Records included those of both historical and recent occurrence and were scattered throughout the state (Appendix A).

The database of historical and recent records was created from inquiries consisting of questionnaires and personal contacts (1998-2001) regarding burrowing owls. Federal and state land management and resources agencies, independent biologists, and bird-enthusiasts throughout the state were contacted. Arizona Breeding Bird Atlas (ABBA: AZGFD 1993-2000) information was acquired and location information was sought from literature searches, including published and unpublished reports and notes (Brown 2001b). The database was then reduced to include all the ABBA blocks that were reported to have had burrowing owls and all sites whose descriptions were sufficient to

relocate them, resulting in 206 sites. Many sites required a permit to survey for owls and applications were submitted in early 2001. A few permits were not granted which reduced the database to 188 sites (Appendix D).

We conducted visual surveys at sites during the breeding season (from March to August 2001), and in winter season (January and February, 2002). We also used the playback survey method (Haug and Didiuk 1993) at a limited subsample of the breeding season surveys. In winter, visual surveys focused on the areas where burrowing owls were found in the breeding season to determine use of the area by the owls in the winter. If possible, the area was searched to determine the specific location of the nest burrow, and to determine if owls were in the area.

Visual surveys consisted of a 360 degree scan with binoculars (and occasionally a spotting scope) every 0.3 km along roads throughout the designated survey area (site), spending two to five minutes at each stop. The 0.3 km distance was modified (extended or shortened) if factors did not permit the survey effort to take place at that distance (e.g., inability to pull off the road or stop safely, visibility was obstructed, dense vegetation, residences were in close proximity/privacy, was asked to leave the area, etc.). The number of stops at each site varied depending on the accessibility (existence of roads) and specificity of the location, but the effort did not exceed two hours at any site. The survey effort may have been abandoned if we deemed the area completely unsuitable for burrowing owls (e.g., commercial development, dense trees, or other vegetation), or if we could not access the area.

ABBA blocks were approximately 26 square km (ten square miles) in size (equal to one-sixth of a 7.5 minute topographic map). We attempted to survey along every accessible road in the block (without overlapping the survey effort). We surveyed along all accessible roads within 1.6 km of all other sites. In sites where we were not able to safely pull off the road, we scanned the site while driving slowly along all accessible roads.

During the breeding season, we conducted visual surveys from sunrise to 1330 and 1530 to sunset, attempting to avoid the hottest temperatures of the day. Winter surveys were conducted during the warmest part of the day (0900-1600). Due to the variation in temperatures across the elevations, we initiated breeding season surveys in the southern portion of the state, and winter surveys in the northern portion of the state.

We conducted the playback surveys with calls (the 'song' and alarm call) taped from Peterson's Western Bird Songs, a cassette walkman, and a modified megaphone set at a moderate level. Although the responses of different species to taped calls vary (Smith 1990), the burrowing owl is known to respond to playback recordings (Haug and Didiuk 1993). Playback surveys were conducted from dusk until three hours after sunset. We established playback stations along roads every 0.8 km because the tapes could be heard beyond 0.3 km. At each station, we listened for one minute, played the tape for one minute, and then listed again for three minutes. During the minute broadcast of calls, the speaker was rotated 360 degrees to allow the calls to be broadcasted in all compass directions.

We recorded the following information during the visual and playback surveys: the number of owls detected; method of detection; direction and estimated distance of the observation or detection (playback surveys); age of owls (adult or juvenile), if possible; description of the environment where owls were observed; activity of the owl; and when possible, description and location of burrow (nest or satellite). We mapped the locations of the owls and known nest burrows on 7.5-minute topographic maps and Universal Transverse Mercator (UTM) coordinates were calculated for all known nests. Incidental observations of burrowing owls (i.e., those outside survey sites) were also recorded.

The location of the owl was described as microhabitat and macrohabitat (surrounding area). The vegetation types in which the owls were detected were recorded following that of the ABBA classification (Arizona Breeding Bird Atlas 1993-2000). However, the *Rural* and *Residential* classifications were further divided to allow more specificity (Appendix B).

The literature search for historical and recent information on burrowing owls in Arizona was continued. Questionnaires (Appendix C) were also sent to various wildlife rehabilitation centers and other contacts throughout the state in order to determine frequency of calls about burrowing owls and the number of owls treated.

RESULTS

BREEDING SEASON SURVEYS

There were 281 records of burrowing owl locations in the original database, which we reduced to 206 based on the ability to determine where the sites were located. We could not obtain permits for 18 sites, which further reduced the total survey sites to 188. Of the 188 sites, we could not survey 24 for a variety of reasons, resulting in a total of 164 sites surveyed, of which 15 sites were only partial surveys. During the 2001 breeding season, burrowing owls were observed

at a total of 29 sites (17.7 % of the 164 sites), plus four additional locations found opportunistically (89 owls and 19 young; Appendix D). Burrowing owls were detected at only one of the 15 sites that obtained partial surveys. Excluding the 14 partial surveys where no owls were detected, this would result in 19% of the 150 sites surveyed detected the presence of burrowing owls.

Of the 188 sites to be surveyed in 2001, there were total of 87 ABBA blocks; of these, 59 were full survey efforts, 10 were partial survey efforts, and 18 were not surveyed. There was one block (Wellton Mesa, Yuma Co.) where no owls were detected in the visual survey, but two owls were detected in a playback survey. Of the 29 sites where owls were found, 21 were ABBA blocks (including the playback survey); thus of the 69 ABBA blocks surveyed, burrowing owls were only found in 30% of them. Burrowing owls were not detected in the 10 ABBA blocks that obtained only partial surveys; thus of the 59 blocks that were full survey efforts, 36% of these detected the presence of burrowing owls. Ninety of the remaining 119 sites (specific locations) were full survey efforts, two were partial survey efforts, three were drive-by surveys, and 24 were not surveyed. At only eight (8.4%) of the 95 specific sites were burrowing owls found. If the partially surveyed sites (including the drive-bys) where owls were not detected were excluded, this would result in 8.8% (8 of 91) of the specific sites surveyed contained burrowing owls.

The area where the most owls were found was in and around Yuma. The burrowing owls found in this area were primarily associated with burrows along concrete-lined irrigation canals in agricultural areas (6 pr, 6 owls). Other nests found in the Yuma area were in creosote flats (Sonoran Desertscrub) and along a main canal.

The microhabitats used by nesting burrowing owls in 2001 is ranked (high to low) as follows: irrigation canal (primarily concrete-lined canals), prairie dog town, creosote flat, canal/levee, pasture, Great Basin Desertscrub, nestbox, old prairie dog town, plowed area (culvert), Great Basin Grassland, and fallow field. The macrohabitats used by nesting burrowing owls were agricultural, Great Basin Desertscrub, Semidesert Grassland, urban, rural, Plains Grassland, pasture, residential, and Great Basin Grassland (Appendices E and Fb). The UTM's for the nest sites have been provided to the Arizona Game and Fish Department.

WINTER REVISITS

We revisited 97% (32 of 33) sites where burrowing owls were found in the breeding season. Similar to the nesting results, the primary areas where the owls were found in the winter were irrigation canals in agricultural areas (Appendix E and Fb).

There was one breeding ABBA block where three nests were found that was inaccessible in the winter, and thus the specific UTM's and nest locations were not documented. (This was also an agricultural area with nests on a levee overlooking the fields and one along an irrigation canal.) Also, there was one additional site where an owl was observed only in the winter via a drive-by incidental observation (along an irrigation canal). Of the 33 sites where owls were found in the breeding season, only 27.3% (nine sites), plus the one additional site, had owls in the winter (16 owls). The wintering owls were found throughout the state, but Cibola National Wildlife Refuge (La Paz County) and Pinal County supported the most owls (5 and 4 respectively; Appendices D, Fa, and Fb).

LITERATURE SEARCH

An annotated bibliography on burrowing owls in Arizona was completed as a result of the literature and document search (Appendix G). There were 70 references found regarding burrowing owls in Arizona, eight of which were not personally reviewed.

WILDLIFE REHABILITATION SURVEYS

Of the 14 wildlife rehabilitation persons contacted, all responded. The majority of the rehabilitators were located in the Phoenix and Tucson area. There were only two contacts in northern Arizona. The rehabilitators in northern Arizona informed us that they rarely receive calls about burrowing owls and only received an estimated three burrowing owls in several years. All of the active rehabilitators in central and southern Arizona receive anywhere from one to 50 calls (typically 2-15) per year regarding burrowing owls; many of which may be from concerned citizens about an owl on the ground, or the need for relocation due to construction. Forty-three percent of the responses to the surveys suggested an increase in calls regarding the owls over the last five years. It was suggested that the increase in construction and, hence, the need for relocation of the owls has caused the increase in calls, particularly in the Phoenix and Tucson metropolitan areas. Twenty-one percent of the responses mentioned that the number of calls concerning burrowing owls has remained constant and 21% mentioned a decrease in calls. However, it was suggested by the respondents that the decrease in calls was due to the lack of remaining habitat for the owls.

The main reason rehabilitators received calls about burrowing owls concerned injuries (i.e. head trauma, wing injuries, harassment by children with b.b.guns and rocks, other impact injuries from vehicles and trains, and poisoning). If the owls are able to heal from the injuries, all rehabilitators (100%) released owls in the area where the owls were found, or another area thought to be suitable. Although most rehabilitators conduct their own education programs, there was an overall agreement (93%; 13 of 14) that additional public awareness and education on burrowing owls would be beneficial.

DISCUSSION

In 2001 breeding season survey effort, burrowing owls were not found in 82.3% of the locations where they formally nested in Arizona (the latter based on Brown 2001b; 80.7%, if we omit the 14 partial surveys where no owls were observed). Although there was an apparent decline of nesting populations at these locations, we cannot extrapolate this to be a decline throughout the state. In addition to the fact that the survey effort was not state-wide and was limited to one year, environmental conditions (changes in rainfall and prey availability) are other factors that may have played a part in the absence of the owls at these sites. There were also limitations of the 2001 survey technique, particularly road transects and one-time visits, that may have been additional factors. More owls were found on the larger ABBA blocks than on the more numerous specific sites (29% versus 8.4%). According to records and the literature, southeastern Arizona used to support high levels of both prairie dogs and burrowing owls (Bendire 1892, Bent 1938, Phillips et al. 1964, Brown 2001b: Appendix A); however, prairie dogs in southeastern Arizona were extirpated years ago. In the 2001 breeding season, there were no burrowing owls (0%) observed in 21 former breeding locations in southeastern Arizona (Cochise and Santa Cruz counties). Numerous burrows were observed during surveys in these locations. However, most of the burrows observed had cobwebs and no physical or visual evidence of any current or recent activity (e.g., footprints, feathers, whitewash, pellets, scat).

Although deVos (1998) suggested burrowing owls were year-round residents throughout Arizona, both Phillips et al. (1964) and our survey effort suggest otherwise. The winter of 2001 in Arizona was mild and owls were year-round residents throughout the state. However, between the summer and winter seasons in 2001, there was a drastic decline in burrowing owl numbers. The decline may be from migration, but there was also evidence of human and other predatory impacts. There were a few sites (primarily irrigation canals in agricultural areas) where the nest burrows were destroyed (filled-in), one site where remains of an owl were found, and another site where a predated burrowing owl egg and a kit fox (*Vulpes macrotis*) skull were found outside of the burrow. Estabrook and Mannan (1998) also noted impacts to the burrowing owl burrows along the canals and washes in Tucson, and T. Pinto (pers. comm., Flood Control District of Maricopa Co. 2002) also noted destruction of known burrowing owl burrows along canals in Phoenix within the past year. Hence, there is a great deal of human impact on the owl's most important habitat in Arizona, which suggests it may add to the decline of this species in Arizona.

In light of the consistent growth in the metropolitan areas in Arizona, a potentially important management strategy would be to establish state-wide mitigation

protocols as processes for development or any type of construction. An example of this would be encouraging developers to compensate for the habitat destruction by providing either alternate areas of habitat (i.e., preserves) or a monetary donation for such habitat, and providing funding for the relocation of owls to appropriate areas. Another beneficial element would be to provide educational programs about burrowing owls to the public, particularly the agricultural community and the city and county personnel in Arizona in order to assist in the prevention of a further decline.

LITERATURE CITED

Arizona Breeding Bird Atlas. Unpubl. data (1993-2000). Arizona Game and Fish Dept., Nongame Branch, Phoenix, AZ.

Bendire, C. 1892. Life histories of North American birds with special reference to their breeding habits and eggs, with twelve lithographic plates. U.S. Govt. Printing Office, Washington, DC.

Bent, A. C. 1938. Life histories of North American birds of prey. Part 2. U.S. Natl. Mus. Bull. No. 170.

Brown, N. L. 2001a. Appendix A: State Summaries of Burrowing Owl Status: Arizona. Pages 40-43 in the Draft Status Assessment and Conservation Plan for the Burrowing Owl in the United States. (Anderson, S. H., L. W. Ayers, J. A. Dechant, M. T. Green, W. H. Howe, S. L. Jones, D. S. Klute, D. K. Rosenberg, S. R. Sheffield, T. S. Zimmerman, Eds.) U.S.F.W.S., Denver, CO.

Brown, N. L. 2001b. The Howdy Owls of Arizona: A Review. Proceedings of the Second International Burrowing Owl Symposium, Ogden, Utah, 28-29 September, 1998. *J. Raptor Res.* 35:344-350.

deVos, J. C., Jr., 1998. Burrowing Owl (*Athene cunicularia*). Pages 166-169 in The Raptors of Arizona (R. L. Glinski, Ed.). Univ. of Arizona Press, Tucson; Arizona Game and Fish Dept., Phoenix, AZ.

Estabrook, T. S., and R. W. Mannan. 1998. Urban habitat selection by Burrowing Owls: Final report. Heritage Grant U96006; Arizona Game and Fish Dept., Phoenix, AZ.

Glover, F. A. 1953. Summer foods of the Burrowing Owl. *Condor* 55:275.

Haug, E. A., and A. B. Didiuk. 1993. Use of recorded calls to detect Burrowing Owls. *J. Field Ornithol.* 64:188-194.

Johnson, R. R., L. T. Haight, and J. M. Simpson. 1979. Owl populations and species status in the southwestern United States. Pages 40-59 *in* Proceedings of the National Audubon Society's symposium on the Owls of the West: their ecology and conservation (P. P. Schaeffer and S. M. Ehlers, Eds.). Tiburon, CA.

Johnson-Duncan, E. E., D. K. Duncan, and R. R. Johnson. 1988. Small nesting raptors as indicators of change in the southwest desert. Pages 232-236 *in* Proceedings of the Southwest Raptor Management Symposium and Workshop, 1986 (Glinski, Pendelton, Moss, LeFranc, Millsap, Hoffman, Eds.) Nat. Wild. Fed. Sci. and Tech. Series No. 11. Washington, DC.

Latta, M. J., C. J. Beardmore, and T. E. Corman. 1999. Arizona Partners in Flight Bird Conservation Plan. Version 1.0. Nongame and Endangered Wildlife Program Technical Report 142. Arizona Game and Fish Dept., Phoenix, AZ.

Monson, G., and A. R. Phillips. 1981. Annotated checklist of the birds of Arizona. Univ. of Arizona Press, Tucson, AZ.

Phillips, A., G. Monson, and J. Marshall. 1964. The Birds of Arizona. Univ. of Arizona Press, Tucson, AZ.

Rosenberg, K. V., R. D. Ohmart, W. C. Hunter, and B. W. Anderson. 1991. Birds of the Lower Colorado River Valley. Univ. of Arizona Press, Tucson, AZ.

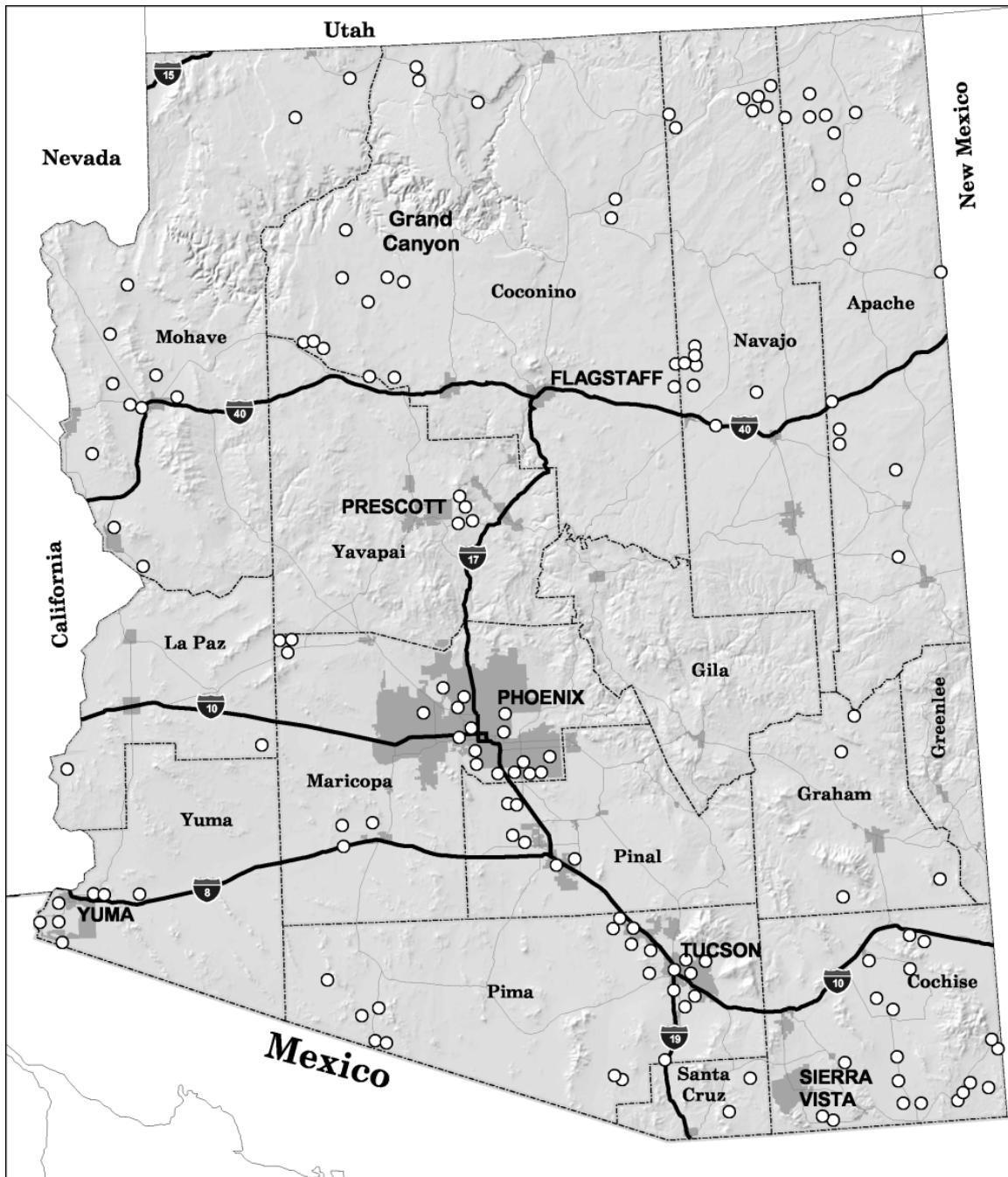
Smith, D. G. 1990. A review of the methods to locate and census owls of the southeast. Pages 228-238 *in* Proceed. Southeast raptor management symposium. Nat. Wildl. Fed., Washington, DC.

U.S.F.W.S. 1995. Migratory nongame birds of management concern in the United States: The 1995 list. Office of Migratory Bird Management, Washington, DC.

APPENDIX A

MAP A

Historical and Recent Burrowing Owl Distributions in Arizona



Burrowing owl survey 2001

○ Sites surveyed in 2001

50 0 50 100 150 Kilometers

25 0 25 50 75 100 Miles



APPENDIX B

Habitat Classifications

Habitat Classifications

(based of the ABBA classifications)

Grasslands

Great Basin Grassland – scattered pinyon and juniper

Plains Grassland – predominantly flat and open continuous grassland, primarily between 5,000 and 7500 feet in elevation (northern Arizona)

Semidesert Grassland – often with scattered sotol, agaves, burroweed, snakeweed, yucca, mesquite

Sonoran Savanna Grassland – scattered mesquite, ironwood, palo verde

Desertlands

Great Basin Desertscrub – sagebrush, blackbrush, shadscale

Mohave Desertscrub – Joshua tree, creosote bush, saltbush

Chihuahuan Desertscrub – creosote bush, tarbush, whitethorn acacia

Sonoran Desertscrub:

1) Lower Colorado River Biome – mesquite, saguaro, creosote bush, white bursage, brittlebush, saltbush

2) Arizona Upland Biome – paloverde, ironwood, mesquite, catclaw acacia, saguaro, cholla, barrel cactus, prickly pear, creosote bush, jojoba, crucifixion-thorn

Urban/Agricultural

Residential -- (ornamental plantings, yards, residential ponds, lakes, canals)

Canals

Lakes/ponds

Wash(es)

Developed/Being developed

Parks --

City parks planted to grass and trees

Golf courses

Cemeteries

Airports

Industrial – downtowns, commercial districts, warehouses, little vegetation

Rural – scattered farm buildings/homesteads

Feedlots

Shelterbelts

Sewer and settling ponds

Canals/Levees

Pastures

Cultivated Woodlands – orchards, tree farms

Agricultural – grain fields, hayfields, cotton fields, etc

Irrigation canals

Barren Ground – plowed fields

Disturbed areas, fallow fields (tumbleweeds, etc)

APPENDIX C

Arizona Burrowing Owl Questionnaire

Arizona Burrowing Owl Questionnaire

Nikolle Brown
Wildlife Biologist
SRNR, Biol. Sci. East 104, University of Arizona
Tucson, Arizona 85721

The purpose of this questionnaire is *to further assess the known or potential impacts to the Burrowing Owl in Arizona*. This questionnaire is a part of a larger project on Burrowing Owls in Arizona that has been funded by the Arizona Game and Fish Department's Natural Heritage Program (2000-2002); field surveys will also be conducted. I would greatly appreciate your time to answer the questions in as much detail as possible and return it by APRIL 2001. (A return envelope has been provided.)

- 1) Have you received calls about Burrowing Owls? yes no
- 2) What is the estimated number of calls regarding Burrowing Owls per year? _____
- 3) Have you seen an increase or decrease in the calls about Burrowing Owls over the last 5 years? _____
- 4) What have been the reason(s) behind the calls? (answer yes/no, add anything else)
 - a) injured owl(s)? _____
 - b) if so, was origin of the injury(s) known? (such as car collision, pet attack, natural predator, etc.) _____
 - c) abandoned owl(s)? _____
 - d) need for relocation? _____
 - e) other, please specify _____
- 5) What is the estimated number of Burrowing Owls treated at your center per year?
Reasons for treatment: _____
- 6) Do you refer the callers to another center or agency? _____
If so, to whom do you refer them? _____
- 7) Do you release the recovered owls? _____
If so, where do you typically release them? (location, habitat, etc.) _____
- 8) Do you feel a public educational program in your area would help protect the Burrowing Owl? _____
- 9) Other comments? _____

Thanks again for your time, Nikolle Brown

APPENDIX D

Total Number of Surveys and Owls by County

Total Number of Surveys and Owls by County

County	Sites	Not Surveyed	Partial	w/ Owls	Owl #	Winter: w/Owls	Owl #
Apache	16	1	1	4	11 (+4 young)	1	1
Cochise	24	5	2	0	0	0	0
Coconino	26	12	0	3	4 (+5 young)	1	1
Graham	5	0	0	0	0	0	0
Greenlee/Cochise	1	1	0	0	0	0	0
La Paz	5	2	0	2	10	1	5
Maricopa	30	4	4	3 + 2 off	9	1 + 1 off	2
Mohave	13	1	3	1	1 (+2 young)	1	1
Navajo	27	8	0	5	12 (+8 young)	1	1
Pima	35	7	4	2	6	0	0
Pinal	9	0	1	4	10	2	4
Santa Cruz	2	0	0	0	0	0	0
Yavapai	6	1	0	0	0	0	0
Yuma	7	0	0	5 + 2 off	26	1	1
Totals	206*	42*	15	29 (+4 off)	89 +19 young	9 + 1 off	16

* There were 18 sites where permits were not granted, reducing the total to 188 sites and of those, 24 were not surveyed. (164 sites were surveyed, including the 15 partial surveys).

APPENDIX E

Ranking of Habitat Given the Number of Owl Nests Found

Ranking of Habitat Given the Number of Owl Nests Found

Microhabitat	Breeding	Winter
Irrigation canal	12 pair, 14 owls	1 pair, 5 owls
Prairie dog town	7 pair, 4 owls	1 owl
Creosote/ Sonoran Desertscrub	3 pair, 4 owls	1 owl
Canal/levee	1 pair, 5 owls	0
Pasture	3 owls	2 owls
Great Basin Desertscrub	1 pair, 1 owl	1 owl
Nestbox/Agricultural	1 pair, 1 owl	1 pair
Old prairie dog town	1 pair, 1 owl	0
Plowed area (culvert)	2 owls	1 pair
Plains Grassland	1 owl	0
Fallow field	1 owl	0

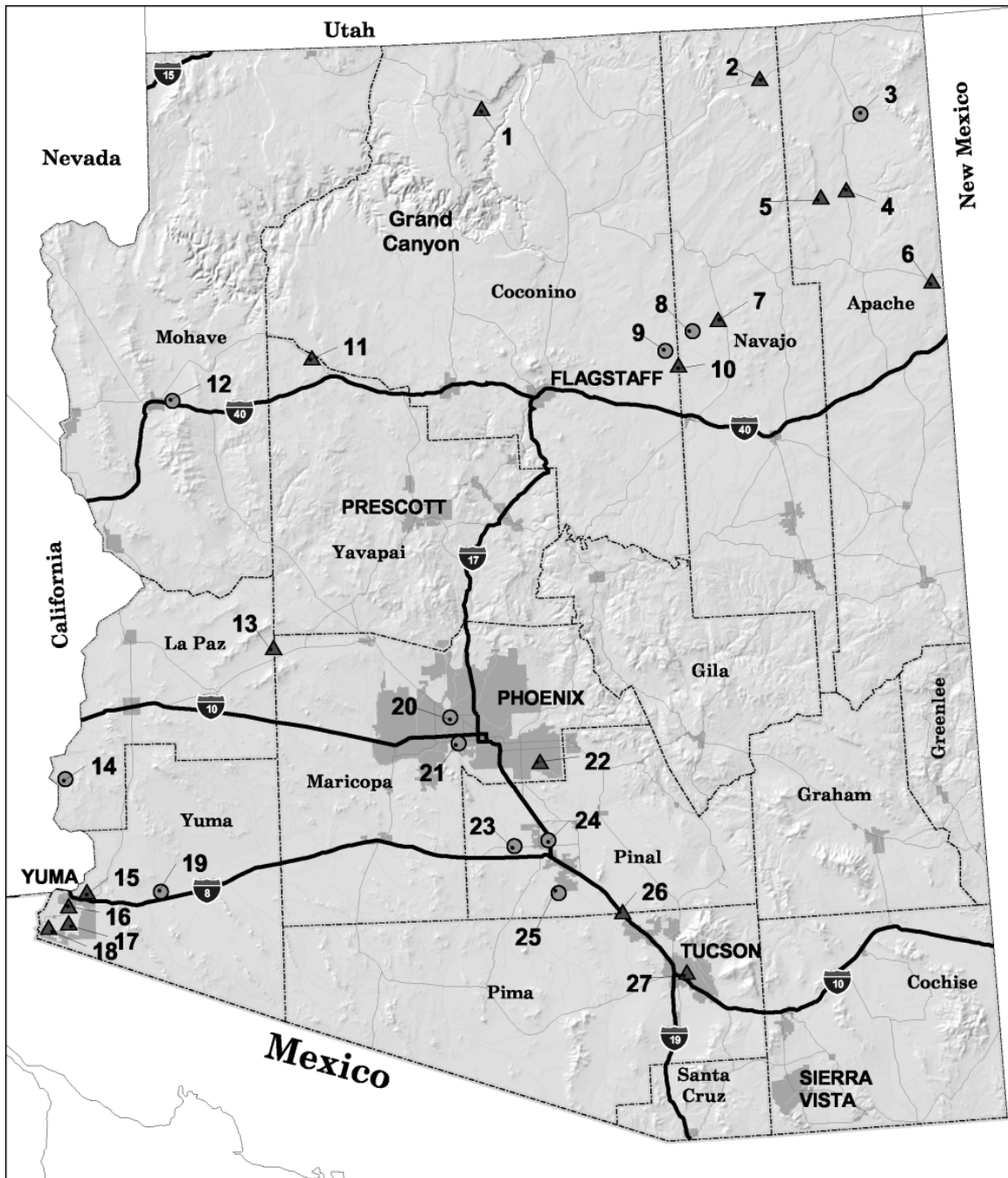
Macrohabitat	Breeding	Winter
Agricultural	13 pair, 19 owls	2 pair, 5 owls
Great Basin Desertscrub	5 pair, 1 owl	1 owl
Semidesert Grassland	3 pair, 4 owls	2 owls
Urban	1 pair, 4 owls	1 pair
Rural	2 pair, 3 owls	2 owls
Residential	1 pair, 3 owls	0
Plains Grassland	2 owls	0
Pasture	1 pair	0
Great Basin Grassland	1 owl	0

APPENDIX F a and b

a) MAP B

Locations of Burrowing Owls Found in 2001

b) Map B Reference Data



APPENDIX G

Annotated Bibliography of Burrowing Owls in Arizona

**Annotated Bibliography
of
Burrowing Owls in Arizona**

Arizona Breeding Bird Atlas. Unpubl. data (1993-2000). Arizona Game and Fish Dept., Nongame Branch, Phoenix, AZ.

Bailey, F. M. 1923. Birds recorded from the Santa Rita Mountains in southern Arizona. *Pac. Coast Avifauna* No. 15.

(p. 19): "One was seen by Dr. C. T. Vorhies, of the University of Arizona, October 19, 1919, at the old wooden gate below McCleary's." --on the west side of the range, at 4,000ft at 'now' Nicholson's Ranch, where the HQ of the U.S. Range Reserve Experiment Station; near Stone Cabin Canyon.

_____. 1939. Among the birds in the Grand Canyon country. U.S. Govt. Printing Office, Washington, DC.

Has 4 records in the area from approximately 1928-mid-1930's.

Bendire, C. 1892. Life histories of North American birds with special reference to their breeding habits and eggs, with twelve lithographic plates. U.S. Govt. Printing Office, Washington, DC.

In Arizona "it is somewhat rarer" (than the 'common' of California).

Bent, A. C. 1938. Life histories of North American birds of prey. Part 2. U.S. Natl. Mus. Bull. No. 170.

A nest was dug out in the prairie of Cochise Co. on 26 April 1922: found female on nine fresh eggs.

Blake, J. G. 1978. Birds of the Lake Mead National Recreation Area, Nevada/Arizona. LAME Technical Report No. 1.

'Rare to uncommon resident', occurring more frequently in the southern portion of LAME, particularly near Katherine Landing.

Bradfield, M. 1974. Birds of the Hopi region, their Hopi names, and notes on their ecology. Mus. of Northern Arizona Bull. No. 48. Flagstaff, AZ.

The author never saw the owl, but was told it was a resident on the main valley floor. Hopi name for the owl is ko'ko.

Bradley, Z. A., and C. D. Lewis, Jr. 1965. A bird checklist for Wupatki and Sunset Crater National Monuments. (AZ).

They cite Merriam (1890) as saying that burrowing owls were "abundant throughout the pinon pine, and spruce zones, and common in parts of the desert where there are bushes for it to perch on." However, this statement is actually what Merriam says of the Sparrow Hawk or kestrel. Yet, they state that there were no modern records of burrowing owls at Wupatki.

Brandt, H. 1951. Arizona and Its Bird Life. Bird Research Foundation, Cleveland, OH.

Notes and observations on this owl and vegetation changes in southeastern Arizona.

_____. 1952. Arizona and its bird life. *Arizona Highways* 28(5):16-29.

Burrowing owls are mentioned in the desert grassland portion of the schematic cross section of a high desert mountain range that is replicated from the text.

Breninger, G. F. 1901. A list of birds observed on the Pima Indian Reservation, Arizona. *Condor* 4(3):44-46.

(p. 45) "One seen on the desert" in September; the desert was away from the irrigated, cultivated lands adjacent to the Gila River above the junction with the Salt River.

Brown, B. T., S. W. Carothers, L. T. Haight, R. R. Johnson, and M. M. Riffey. 1984. Birds of the Grand Canyon region: An annotated checklist. Second edition. Grand Canyon Natural History Assoc., AZ.

Used to be found in prairie dog towns near Anita and Pasture washes on South Rim, not observed since 1935 in the park. May still occur in open areas on the South Rim and in Toroweap Valley on North Rim. List breeding dates postulated from "available data": 9 April-28 October.

_____, S. W. Carothers, R. R. Johnson, M. M. Riffey, and L. E. Stevens. 1993. Checklist of the birds of the Grand Canyon region. Grand Canyon Natural History Assoc., AZ.

Former summer resident, no longer occurs.

Brown, N. L. (1998). Priority Species Account for High Elevation Grasslands: Burrowing Owl (*Athene cunicularia*). Submitted to Arizona Partners in Flight, Arizona Dept. of Game and Fish, Phoenix, AZ.

Brown, N. L. 2001a. Appendix A: State Summaries of Burrowing Owl Status: Arizona. Pages 40-43 in the Draft Status Assessment and Conservation Plan for the Burrowing Owl in the United States. (Anderson, S. H., L. W. Ayers, J. A. Dechant, M. T. Green, W. H. Howe, S. L. Jones, D. S. Klute, D. K. Rosenberg, S. R. Sheffield, T. S. Zimmerman, Eds.) U.S.F.W.S., Denver, CO.

Brown, N. L. 2001b. The Howdy Owls of Arizona: A Review. Proceedings of the Second International Burrowing Owl Symposium, Ogden, Utah, 28-29 September, 1998. *J. Raptor Res.* 35:344-350.

An overall summary of what is known about the burrowing owl in Arizona.

Carothers, S. W., R. P. Balda, and J. E. Hildebrand. 1970. A checklist of the birds of Flagstaff, Arizona. Mus. of Northern Arizona, Flagstaff, AZ.

Rare, permanent resident of grasslands.

_____, J. R. Haldeman, and R. P. Balda. 1973. Breeding birds of the San Francisco Mountain Area and the White Mountains. Tech. Series. No. 12. Northern Arizona Soc. of Science and Art, Inc., Flagstaff, AZ.

Locally common permanent resident of the grasslands northeast of the San Francisco Peaks. 2 April 1970- a female burrowing owl hit a window of a Flagstaff home-first record of this species in the ponderosa pine vegetation type in Arizona.

Coues, E. 1874. Birds of the Northwest. U.S.G.S., Govt. Printing Office, Washington, DC.

"Occur in various parts of Arizona, living with... *Cynomys* var. *gunnisoni*".

deVos, J. C., Jr. 1998. Burrowing Owl (*Athene cunicularia*). Pages 166-169 in The Raptors of Arizona (R. L. Glinski, Ed.). Univ. of Arizona Press, Tucson; Arizona Game and Fish Dept., Phoenix, AZ.

General overview of the species.

Estabrook, T. S., and R. W. Mannan. 1998. Urban habitat selection by Burrowing Owls: Final report. Heritage Grant U96006; Arizona Game and Fish Dept., Phoenix, AZ.

First 'study' on this owl in Arizona: Tucson. Davis-Monthan AFB had large density as did the Santa Cruz River banks. They found mourning doves as part of diet and provided canal management recommendations.

Fisher, A. K. 1893. The hawks and owls of the United States in their relation to agriculture. U.S. Dept. of Agriculture, Bull. No. 3. Govt. Printing Office, Washington, DC.

Stomach contents of birds collected in the Verde Valley, Camp Verde, Phoenix, and Wilcox: insects (scorpions, grasshoppers), lizards. A reference to a roof of a house being a favored eating spot of an owl in Arizona, below which had a pile of scorpion remains.

Gilman, M. F. 1909. Some owls along the Gila River in Arizona. *Condor* 11(5):145-150.

Found them to be rare near Sacaton, Pinal Co., saw only 4 owls; but said to be more numerous down on the Gila River.

Glover, F. A. 1953. Summer foods of the Burrowing Owl. *Condor* 55:275.

A note on diet in agricultural area of Mesa Valley: scorpions, lamellicorn beetles (Scarabidae), locusts, ground beetles (Carabidae), pocket mice, and kangaroo rats. Stated importance of natural insect control provided by burrowing owls.

Grater, R. K. 1937. Check-list of birds of Grand Canyon National Park. Grand Canyon Natural History Association, AZ. Nat. Hist. Bull. No. 8.

South Rim: rare, casual visitant, June. Pinyon belt, Upper Sonoran Zone; Canyon Bottom: rare, Casual visitant, September. Open flats in Lower Son. Zone; South of canyon: rare, summer visitant. Seen in prairie dog towns near Anita up to 1928 (by Ranger Sturgill), Upper Son. Zone; Toroweap: rare transient visitant, April. Open flats in Upper Son. Zone. E. D. McKee also found one sitting in road in House Rock Valley on 28 Oct 1934.

Groschupf, K. D., B. T. Brown, and R. R. Johnson. 1988. An annotated checklist of the birds of Organ Pipe Cactus National Monument, Arizona. Univ. of Arizona Cooperative National Park Resources Studies Unit., Tucson, AZ.

Irregular transient found on creosote bush flats in the western portion of the monument.

Hargrave, L. L. 1932. Miscellaneous birds notes from the San Francisco Mountains. U.S. Dept. Interior, National Park Service, Grand Canyon NP, Tech. Bull. No. 5a. Grand Canyon, AZ.

Unverified sighting in upper Deadman's Flat during summer 1930. (p.15) "Last record for the region is from Merriam, 1889".

Haug, E. A., B. A. Millsap, and M. S. Martell. 1993. Burrowing Owl (*Speotyto cunicularia*). In *The Birds of North America*, No. 61 (A. Poole and F. Gill, Eds.). The Academy of Natural Sciences, Philadelphia; The American Ornithologists' Union, Washington, DC.

Cites Breeding Bird Survey data from 1980-1989 which shows increases in populations in the Lower Sonoran Deserts and Lower Colorado River Valley in western Arizona.

Henshaw, H. 1875. Report upon geographical and geological explorations and surveys west of the 100th meridian, by Lt. George M. Wheeler. Vol. 5:409-410.

Not a very abundant resident in either Arizona or New Mexico; seen near Camps Grant and Bowie in prairie dog towns (one female specimen collected 9 Oct 1873 at Camp Bowie).

Huey, L. M. 1939. Birds of the Mount Trumbell region, Arizona. *Auk* 56(3):320-325.

Two birds were seen on fence post between Wolf Hole and Mt Trumbell post-office.

Jacobs, B. 1986. Birding on the Navajo and Hopi Reservations. Jacobs Publishing Co., Sycamore, MO.

Provides records and general locations in northeastern Arizona.

James, P. C., and T. J. Ethier. 1989. Trends in the winter distribution and abundance of burrowing owls in North America. *American Birds* 43:1224-1225.

Based on CBC's, detected no significant change in Arizona in a 33-yr period. California had a highly significant decrease and based on yearly means was considered the most important state for these owls in the winter, followed by NM, FL, AZ, Mexico, TX, and LA.

Jenks, R. 1932. Ornithology of the life zones: Summit of San Francisco Peaks to bottom of Grand Canyon. U.S. Dept. Interior, National Park Service, Grand Canyon NP, Tech. Bull. No. 5. Grand Canyon, AZ.

Summer resident on mesa above Little Colorado River and San Francisco Mountains.

Johnson, R. R., L. T. Haight, and J. M. Simpson. 1979. Owl populations and species status in the southwestern United States. Pages 40-59 in *Proceedings of the National Audubon Society's symposium on the Owls of the West: their ecology and conservation* (P. P. Schaeffer and S. M. Ehlers, Eds.). Tiburon, CA.

Summary of lack of knowledge of owls, including burrowing owls in the southwest.

Johnson-Duncan, E. E., D. K. Duncan, and R. R. Johnson. 1988. Small nesting raptors as indicators of change in the southwest desert. Pages 232-236 in *Proceedings of the Southwest Raptor Management Symposium and Workshop, 1986*. (Glinski, Pendelton, Moss, LeFranc, Millsap, and Hoffman, Eds.). Nat. Wild. Fed. Sci. and Tech. Series No. 11. Washington, DC.

Information from 1979 reiterated stating inadequate information to evaluate status of burrowing owls in the southwest. Also suggested monitoring remaining populations to detect unnecessary environmental degradation.

Kopp, A. 1997. Eccentricity is a byword for the remarkable Burrowing Owl. *Arizona Highways*, March 1997:36-37

Lane, J. A. 1965. A birder's guide to Southeastern Arizona. L & P Press, Denver, CO.

Rare and local permanent residents of the deserts. Has been found along the Santa Cruz River at Cortaro Rd (Tucson) and along Hwy 80, 1-5 mi. west of Rodeo.

Latta, M. J., C. J. Beardmore, and T. E. Corman. 1999. Arizona Partners in Flight Bird Conservation Plan. Version 1.0. Nongame and Endangered Wildlife Program Technical Report 142. Arizona Game and Fish Dept., Phoenix, AZ.

Lists the burrowing owl as a Partners in Flight 'priority' species in the High Elevation Grassland Habitat classification.

McKee, E. D. 1930. Preliminary Checklist of Birds of the Grand Canyon National Park. Tech. Bull. No. 3, Grand Canyon National Park, AZ.

Found in prairie dog town near Anita in 1928 and earlier.

Merriam, C. H. 1890. Results of a biological survey of the San Francisco Mountain region and the desert of the Little Colorado River, Arizona. *North American Fauna* 3:1-36.

Listed as a breeder on the desert of the Little Colorado. (p. 91) "Found on the higher mesas of the desert of the Little Colorado, occupying deserted burrows of Prairie Dogs (*Cynomys gunnisoni*)."

Monson, G., and A. R. Phillips. 1981. Annotated checklist of the birds of Arizona. Univ. of Arizona Press, Tucson, AZ.

Update/addition to 1964 publication.

National Audubon Society. 1985. Checklist of Birds: Research Ranch Sanctuary, Elgin, Arizona. (unpublished checklist).

Lists the burrowing owls as a 'not breeding, but regular visitor' to the ranch and a 'permanent resident in area.'

National Park Service. 1937. Check-list of the birds of the Grand Canyon National Park. *In* Check-list of the birds of the National Parks. Dept. of Interior, Washington, DC. Unpublished, but circulated.

"Rare; two records; south rim, June; canyon bottom, September, 1935."

_____. 1993. Birds of Wupatki and Sunset Crater National Monuments {checklist}. U.S. Dept. of Interior, Washington, DC.

Considered to be an occasional (to be expected/seldom seen) summer resident at Wupatki NM; Not found at Sunset Crater NM.

Osgood, W. H. 1903. A list of birds observed in Cochise County, Arizona. *Condor* 5(5):128-131.

"A large colony was located in a dogtown about 200 yards from the house at Allaire's ranch. A few were seen elsewhere in the valley." The ranch was located in Sulphur Springs Valley, about 10 mi. south of Willcox, and 7 mi. north of Sulphur Spring, on the west side of Wilcox Playa.

Phillips, A. R. 1947. Bird life of the San Francisco Mountains. No. 5: Hawks and Owls. *Plateau* 20:17-22.

Rare, but "probably a summer resident, especially near Howard Lake, north of Williams."

_____, G. Monson, and J. Marshall. 1964. The Birds of Arizona. Univ. of Arizona Press, Tucson, AZ..

Described what is known of the species in the state including a distribution map.

Rhea, A. M. 1983. Once a river: Bird life and habitat changes on the Middle Gila. Univ. of Arizona Press, Tucson, AZ.

Found in Floodplains and Pima Rancheria habitats; the author felt that most owls migrate out in winter.

Rosenberg, K. V., R. D. Ohmart, W. C. Hunter, and B. W. Anderson. 1991. Birds of the Lower Colorado River Valley. Univ. of Arizona Press, Tucson, AZ.

Common resident along LCRV, less common in northern areas in winter; highest numbers in winter (CBC) in Parker (33) in 1979. Did not study breeding habits.

Scott, W. E. D. 1886. On the avi-fauna of Pinal County, with remarks on some birds of Pima and Gila Counties, Arizona. *Auk* 3(2/3/4):249-258/ 383-389/421-432.

(p. 424) "Near Benson which is just outside of the region (of map this article was covering) is a very considerable colony of these birds and I have heard from good observers of another colony NE of Florence. This bird is unusual, however, in this area."

Swarth, H. S. 1904. Birds of the Huachuca Mountains, Arizona. *Pac. Coast Avifauna* 4.

(p. 9) "(Burrowing owls)...are to be seen in considerable numbers in the various prairie dog 'towns' between the Huachucas and the San Pedro River, and a few are scattered elsewhere over the prairies, some coming quite to the base of the mountains."

_____. 1914. A distributional list of the birds of Arizona. *Pac. Coast Avifauna* 10:1-133.

Irregularly and locally distributed throughout valleys in the state. In general, it is said to be common where the prairie dog is found, in the lower Sonoran Valleys of northeastern and southeastern Arizona and decidedly rare elsewhere. Sparingly distributed across the plains of southwestern Arizona.

_____. 1920. Birds of the Papago Saguaro National Monument and the neighboring region, Arizona. Dept. of Interior, National Park Service, Washington, DC.

Burrowing owl only mentioned (p. 54) in list of "Birds seen on the Papago Saguaro NM, AZ, May 30 to June 4, 1917". (Description of PSNM encompassed a large area-from 80 mi. NE of Phoenix to Tonto NM, included Roosevelt Lake, Glade, Fort Apaches Indian Res., south from Solomonsville to Bowie, SW to Benson into Tucson then back up to Phoenix.)

Taylor, Richard C. 1993. Location Checklist to the Birds of Chiricahua Mountains. Borderland Productions, Tucson, AZ.

Rare resident, desert and scrubby valley grasslands; Portal Road; Hwy 80 south of Rodeo, NM; Foothills Road. (p. 16) "Ecologist Jim Brown speculates that the decline of burrowing owls in the 1980's is correlated to a series of wet years that fostered heavy grass stands, possibly providing cover for potential prey items and rendering the habitat unsuitable."

_____. 1995. A Birder's Guide to Southeastern Arizona. American Birder's Assoc., Colorado Springs, CO.

A complete revision of J.A. Lane's 1965 book. Local, uncommon, and declining permanent resident in desert scrub, valley grasslands, and desert fields (up to 4,500 ft). Populations collapsed throughout southeast Arizona in the 1980's.

_____. 1995. Location Checklist to the Birds of the Huachuca Mountains and Upper San Pedro River. Borderland Productions, Tucson, AZ.

Locally extirpated: last record in spring 1990. Desert and scrubby valley grassland; Charleston and Palominas Roads, San Pedro Valley.

Tucson Audubon Society Publications Committee. 1995. Davis and Russell's Finding Birds in Southeastern Arizona. Tucson Audubon Society, Tucson, AZ.

Uncommon resident...but has declined in recent years. Recent reliable areas include the grasslands between Douglas and Portal, and the Sonoita Grasslands.

University of Arizona. 1998. Arizona Vertebrate Habitat Model: Burrowing Owl (*Athene cunicularia*). U.S.G.S. Cooperative Park Studies Unit, Tucson, AZ. Unpublished; Information obtained from W. Halvorson.

U.S.F.W.S. 1995. Migratory nongame birds of management concern in the United States: The 1995 list. Office of Migratory Bird Management, Washington DC.

Listed the burrowing owl as a species of management concern in Region 2 which includes Arizona.

Visher, S. S. 1910. Notes on the birds of Pima County, Arizona. *Auk* 27(3):279-288.
(p. 281) "Several pairs nested in badger holes on the mesa east of Tucson."

Witzeman, J. L., S. R. Demaree, and E. L. Radke. 1997. Birds of Phoenix and Maricopa County, Arizona. Maricopa Audubon Society.

Uncommon local resident in fields and Lower Sonoran Desert: mentioned two locations where habitat change (development and recreation) resulted in abandonment, but mentioned three locations where still can be found (Scottsdale Comm. College, Chandler Airport, and near Painted Rock Dam).

Woodbury, A. M., and H. N. Russell, Jr. 1945. Birds of the Navajo Country. Bull. of the Univ. of Utah, Vol. 35(14). Salt Lake City, UT.

Provided a summary of observations and records of owls in northeastern Arizona.

REFERENCES NOT REVIEWED

Arizona Game and Fish Department. 1976. Wildlife surveys and investigations {raptors}. Report Spec. Performance Report Proj. No. W-53-R-26. Phoenix.

(Listed in the Burrowing Owl Bibl., March 1997; could not locate)

deVos, J. C., Jr., C. R. Miller, S. L. Walchuck, W. D. Ough, and D. E. Taylor. 1983. Final Report for the Biological Resource Inventory: Tucson Division-Phase B CAP Aqueduct, Arizona Game and Fish Dept., Phoenix, AZ.

(deVos [1998] cited it in his chapter on Burrowing Owls in *The Raptors of Arizona*)

Eaton, T. H., Jr., and G. Smith. 1937. Birds of the Navajo Country. National Youth Administration, Berkeley, CA.

Gilman, M. F. Birds of the Pima Indian Reservation in Arizona. Unpublished MS; deposited with Dr. A. R. Phillips, Nuevo León, Mexico.

(Cited in Rhea 1983)

_____. 1937a. Letter and notes in margin to Grand Canyon National Park checklist.

(Referenced in NPS 1937 checklist of Grand Canyon NP)

Kaufman, K., and K. Stenberg. 1988. Calling all owls--three AZ birders set out to break the one-day owling records. *Birder's World* 2:14-18.

(Listed in Burrowing Owl Bibl., March 1997)

Phillips, A. R. 1934. The present status of hawks and owls in Arizona. *Hawk Owl Soc. Bull* 4:15-17.

(Listed in Burrowing Owl Bibl., March 1997; could not locate)

Tyler, A. H., and D. Phillips. 1978. Owls by day and by night. Naturegraph Publishers, Happy Camp, CA.

(Cited in deVos 1998--said it suggested that with the exception of the northeast, burrowing owls are resident everywhere in Arizona)

